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Carbon fluxes from different fire types in the Amazon and Cerrado biomes quantified using Earth-observation based modelling

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Fires in the tropics are linked to both climate and land-use change. While in the Amazon, deforestation-related fires decreased following a substantial reduction in deforestation activities until 2012, there have been recent upturns in deforestation and forest fires. Furthermore, earth system models predict a further increase in the intensity of dry seasons in this region in the 21st century. Therefore, carbon emissions from drought-induced forest fires can counteract further pledged deforestation reductions in the following decades, yet they are only partially accounted for in national carbon emission estimates. Improved assessments of fire impacts, including the carbon fluxes arising from post-fire mortality and regrowth, are therefore highly important.
Combining a range of available satellite products enables spatially specific fire emissions estimations. We developed a remote sensing based approach where biomass maps, observed forest loss, burned area and active fire data are combined to generate updated fuel load and emission estimates. In addition, space-for-time methods are employed to derive estimates of post-fire mortality as a function of pre-fire biomass. This high-resolution model guarantees an improved separation of fire types, and we can report emissions associated with deforestation, forest degradation and savanna fires for the entire Amazon basin and the Brazilian Cerrado at monthly intervals.
Results show that over 2015-2020 fires cause annual gross emissions of ~300 Tg C over the

Amazon and Cerrado. While instantaneous emissions from forest fires are small, the fire-induced mortality and subsequent decomposition cause legacy fluxes which are closer to deforestation fire emissions in magnitude, highlighting their importance. Recent upturns in deforestation fire emissions were observed, including in conservation areas established before 2004. There is overall good agreement with previous instantaneous fire emission estimates from other approaches (GFED4s, GFED 500 m) while remaining disagreements highlight areas of uncertainties, such as combustion completeness values, which could benefit from additional field measurements and spatial modelling supported by EO products.

Outputs from this work can further be used to improve regional greenhouse gas budgets and inform emission reduction and mitigation efforts.